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INSTITUTE FOR DEVELOPMENT STUDIES

UNIVERSITY COLLEGE, NAIROBI.

Discussion paper No. 30

A PROJECTION MODEL FOR THE KENYA ECONOMY:

IMPLICATIONS OF THE KENYA DEVELOPMENT PLAN, 1966-1970.

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September, 1966

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(by H. Karani [1]).

I. Introduction

This paper presents a simple econometric model of the Kenya economy[2] and its aim is to analyse the implications of the Kenya Development Plan, 1966-1970[3], and to check on the internal consistency of its targets.[4]

The model which is presented in the Appendix to this paper is, with a few minor modifications, that outlined in Clark's article referred to above, and its general characteristics are as follows. First, it is a sector model distinguishing six producing sectors of the economy, seven kinds of imports, two classes of exports, four forms of capital formation, four kinds of government taxes, and certain other variables. Thus, it embodies substantially more specific information than an aggregative Keynesian macro-economic model, but still much less detail than is involved in planning development targets within ministries. Second, it portrays an economy in which everything depends, by way of the structural relationships among its parts, upon six autonomous factors: (i) the real quantity of agricultural exports; (ii) the prices of those exports, (iii) the value of manufactured exports and import substitution in manufactured products,

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1 The author is indebted to Dr. B.F. Massell and J. Heyer for their very helpful comments in the course of preparing this paper.

2 For a detailed account of the model, see Paul G. Clark's article: 'The Rationale and Uses of a Projection Model for the East African Economies', East African Economic Review, Vol. 1, New Series, No. 2, June 1965 and also 'Development Planning in East Africa, by P.G. Clark, Chp. IV.

3 Kenya Government, Development Plan 1966-1970, May 1966.

4 For an excellent review of the Development Plan 1966-1970, see 'Kenya's Cautious Development Plan', by Judith Heyer, East Africa Journal, Vol.III No. 5, August 1966.

(iv) central government expenditure on construction, (v) central government expenditure on equipment, and (vi) all other central government current expenditures. Required capital formation is derived within the model from implied increases in domestic production. Third, the parameters describing the structural relationships among parts of economy must each be projected into the future. Some are assumed to remain unchanged or to follow a time-trend, while others are assumed to be adjustable through government policy. Fourth, it is a linear model: capital formation, though in principle non-linear, is represented by a linear approximation depending on a tentative initial estimate of rate of growth. Thus, though the algebra is laborious, it is mathematically simple. Finally, the model is designed to emphasize three potential constraints on development expenditures and policies: the balance of trade, which depends mainly on the various import parameters; the government budget surplus or deficit, which depends mainly on the tax revenue parameters, and the required saving which depends on the capital formation parameters.

The model, as presented in section B of the Appendix, consists of 13 identities, 20 structural equations and 39 variables of which 6 are exogenous;[5] and the structure of the Kenya economy to which it is fitted is as outlined in an earlier article by C. W. Howe and H. Karani.[6] The parameters are shown in Table 1.

The parameters (coefficients) of the model have been calculated from historical values for the period 1957-1963, and serve to characterise the basic features of the economy. Sections B and C of the Appendix define these parameter values.

Perhaps of greater interest, and certainly of great relevance to development planning and forecasting, are the multipliers associated

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[5] An exogenous variable is one whose value is determined by government policy, world market conditions, etc., and is not dependent upon the other variables in the model.

[6] 'A Projection Model for the Kenya Economy: A study in Development Planning and Comparative Economic Structures,' by C. W. Howe and H. Karani, East African Economic Review, Vol. 1, New Series, No. 2, June 1965.

Table 1.

Parameter values for the Kenya Economy.

Parameter	Model Value
a_1	.908
a_2	.022
a_3	.114
c_1	.080
c_2	.077
c_3	.030
g	.718
h_1	.362
i_o	2.430
i_1	.095
i_2	.033
i_3	.301
j_o	3.950
j_1	.250
j_2	.650
k^1	.170
m_1	.118
m_2	.585
m_3	.151
p_1	.513
p_2	.880
q^1	.139
r_1	.105
r_2	-
r_3	.155
r_4	.120
s_o	4.20
s_1	.375
t	.387

with the different types of exogenous expenditure. These multipliers indicate the ultimate impact on the endogenous (or dependent) variables. Table 2 presents the major multipliers, derived by C. W. Howe and H. Karani.

These multipliers show the ultimate implications of the model parameter values of Table 1 on the Kenya economy. The quantity of agricultural exports (in constant prices) has the strongest effect on the expansion of G.D.P.; manufactured exports second; increases in the value of agricultural exports through price increases third; central government non-capital expenditure fourth; and the last two types of central government capital formation last. The explanation for the low multiplier effect of government capital expenditures lies in their large import content.

II. Implications of the Kenya Development Plan, 1966-1970.

Kenya's Development Plan, 1966-1970, published in May 1966, sets various targets in terms of increased G.D.P. and its sector components, employment opportunities, and balance of payments, and proposes various expenditure programmes for the attainment of those goals. It also outlines sources from which money is likely to come to finance the plan. In addition to planned expenditures which are to be undertaken by both the Government and the private sectors, the Plan specifies certain structural changes that are to be brought about not only by directing expenditures, but also through government control, regulation and legislation. The implications of the Plan can be traced in the model by specifying values for the six exogenous variables and by including changes in the structural parameters (presented in Table 1) which are implied by the Plan.

Model projections have been made using the parameter values of the Kenya economy presented in Tables 1 and 2, on the assumption that these parameters will continue to be applicable during the Plan period. The parameters of Table 1 were estimated from historical data for 1957-1963, and since the structure of the Kenya economy is not expected to change very radically during the plan period, it seems reasonable to assume that these parameter values will be fairly realistic for the plan period too.

Table 2

Multipliers of the Model

Endogenous Variables	Exogenous variables						
	Constant (£ mn.)	E_a^*	E_m	T^1	G	Q_{gc}	K_{gc}
G.D.P.	7.821	2.480	1.958	-1.943	1.496	.341	.660
U	7.258	1.441	1.707	- .857	1.386	.318	.271
Y	5.205	1.915	1.466	-1.521	1.147	.181	.481
P_a	.115	.950	.146	-1.033	.025	.004	.011
P_m	.765	.256	.794	- .197	.164	.179	.062
P_s	6.152	.718	.550	- .570	.430	.068	.180
P_t	.340	.467	.364	- .089	.073	.071	.028
P_k	.447	.089	.105	- .053	.085	.020	.379
P_g				0	.718		
K	1.234	.245	.290	- .146	.236	.054	1.046
Q	1.000	.200	.237	- .119	.193	1.044	.038
M	9.313	.867	1.053	- .519	.590	.770	.460
R	2.616	.565	.493	- .423	.350	.160	.179

1 Increases in agricultural export prices cause a downward shift in T. Thus, the multipliers of T are of negative sign.

Projections have been based on the values of exogenous variables shown in Table 3 below. Some of these figures (those for E_a^* and E_m) have been taken directly from the Plan, while others (those for G, Q_{gc} and K_{gc} are estimates based on public sector expenditure statements in the Plan. Expenditure figures in the Plan are given on a fiscal year basis, and so projections have been made in a similar manner.

Table 3.

Values of Variables used in Projections to 1969/70 (£ mn).

	Exogenous Variables						
Year	E_a^*	E_m	T	G	Q_{gc}	K_{gc}	Total exogenous expenditure
1965/66	50.8	26.3	0.5	47.3	1.2	7.2	133.3
1966/67	53.4	27.7	0.5	49.3	2.3	11.5	144.7
1967/68	55.9	29.4	0.6	51.4	2.4	11.9	151.6
1968/69	58.5	30.8	0.6	53.1	1.9	10.1	155.0
1969/70	61.1	32.4	0.6	56.0	1.7	9.9	160.9

The values for central government capital expenditures, Q_{gc} and K_{gc} for the period 1965/66 to 1969/70, have been estimated on a slightly different basis from those given in the plan. The figure relevant for the model is £60.1 million, which is about 83% of the total of £72.1 million given in the Plan.

Table 4 below presents a comparison of model projections for 1964 - 1969/70 with actual data for 1964 and Plan targets for 1964-1970, wherever these are available. There is thus a difference in timing between model projection figures which cover a period of $5\frac{1}{2}$ years and Plan target figures which cover 6 years, but this difference is not likely to be of great significance. Rates of growth are calculated for $5\frac{1}{2}$ and 6 years respectively and these are thus comparable.

Table 4

Comparison of Model Projections with Actual Data and Plan Targets[1]

Endogenous Variables	1964 Actual (£mn.)	1969/70 Model Projections (£mn.)	1970 Plan Targets (£ mn.)	Annual Growth Rate[2] (%)	
				Model 1964-69/70	Plan 1964-70
G.D.P. Monetary	212.79	312.51	321.79	7.3	7.1
Urban Product, U.	160.40	230.94	238.90	6.9	8.0
Private Income, Y.	164.14	238.10	-	7.0	-
Agricultural Product	48.01	63.79	70.85	5.3	6.7
Manufacturing Product	30.13	52.11	47.80	10.5	8.0
Services Product	66.39	93.48	95.30	6.4	6.2
Transport Product	29.77	45.10	44.60	7.8	7.0
Construction Product	4.38	17.80	12.00	29.0	18.3
Government Product	34.11	40.21	51.20	3.0	6.9
Construction Expenditure, annual total	15.11	49.18	-	24.0	-
Government (including E.A.C.S.O.)	7.47	24.10	-	23.7	-
Private	7.64	25.08	-	24.2	-
Equipment Expenditure, annual total	19.41	33.79	-	10.6	-
Government (including E. A. C. S. O.)	3.49	6.08	-	10.6	-
Private	15.92	27.71	-	10.6	-
Gross Investment	34.52	82.97	83.0	17.3	15.7
Govt. % in gross investment	31.75	36.37	38.37[3]	-	-
Gross Investment/ G.D.P. (%)	16.22	26.55	25.49	-	-
Imports, total (M)	87.95	135.0	131.0	8.1	6.9
Balance of Trade (E-M)	-8.52	- 37.2	- 33.0	-	-
Import/G.D.P.(%)	41.33	43.2	40.71	-	-
Central Govt. Revenue(R)	48.65	74.50	-	8.1	-
Budget Surplus	2.60	6.90	-	-	-
R/G.D.P. (%)	22.86	23.83	-	-	-

[1]Model projections refer to the year 1969/70. Plan targets are for the calendar year 1970

[2]There are slight differences in base-year figures because of later statistical revisions, and hence absolute figures are not exactly comparable. Rates of growth are less affected by these minor base year differences.

[3]Average percentage over Plan period.

The purpose of the comparison is to bring out questions about future prospects which this kind of statistical model is designed to raise. The most suggestive points appear to be the following.

(1) Sector Growth of the Economy. The model projects a slightly higher growth rate in G.D.P. and most of its sector components than the Plan, but the difference between the two is small enough to be almost negligible. Most of the Plan targets would, therefore, seem to be quite reasonable in this respect. There are, however, two sectors whose growth performance calls for comment. These are government and construction.

As regards government product, the model projects its annual rate of growth at 3% compared with the Plan figure of 6.9%. Considering the heavy responsibility placed on most governments in countries which are at a similar stage of development to Kenya, it appears as if the model projection is on the low side in this case. Government will be expected to play a leading role in developmental activities during the Plan period in order to accelerate growth in both the public and private sectors of the economy, and the Plan target rate of growth seems to be more realistic than the model projection one.

In the case of the construction product the Plan expects a growth rate of 18.3% per year, compared with the model's figure of 29%. The model projection may be unduly high in this respect, but the difference between the two is large enough to suggest that this sector is likely to expand much more rapidly than the Plan expects, if it is to sustain the indicated rise in the investment rate. According to the model, construction product would be the leading sector in the economy and its high rate of growth could be a main source of employment opportunities.

(2) Imports, In the model, total imports rise somewhat more than in the development plan - at an annual rate of 8.1% as compared to the plan's 6.9%. This rise might imply a tighter foreign exchange constraint during the Plan period than is expected, with a projected deficit in the balance of trade in 1969/70 of the order of £37 million, rather than £33 million

as anticipated in the Plan for the year 1970. The high investment rate (discussed below) projected in the model suggests a higher import bill than the Plan target, but the difference is small enough to be manageable, unless unforeseen events make foreign exchange a critical constraint in Kenya anyway.

(3) Government Budget. In the model projection, government tax revenue expands at 8.1% per year, slightly more than G.D.P., and government expenditure at an annual rate of 7.3%. If this were to be the trend during the Plan period,the inference that could be drawn is that quite reasonable tax rate adjustments in the already comparatively elastic Kenya tax structure would suffice to raise revenue more rapidly than G.D.P. The resulting revenue could then accommodate both a higher trend in current expenditure and a budget any contribution to development of the order of £6.9 million by 1969/70.

(4) Total Gross Investment. The model projections are far higher than Plan targets in this respect. The Plan calls for total gross investment over the Plan period, July 1965 to June 1970, of £325 million; the model projection figure for the same period is about £388 million. If investment that took place in 1964/65 is taken into account, the figure for total gross investment given in the plan for the period 1964/65 to 1969/70, is £360 million, whereas the model projection figure for the same period is £449 million. This is a tremendous difference. This is partly due to the fact that the model takes into account all types of investment including infrastructure; and partly due to the fact that the model reflects a greater shift in the composition of G.D.P. than the Plan toward urban activity and manufacturing which are more capital intensive. But nevertheless it would appear that the Plan underestimates the magnitude of Gross Domestic Investment that is required to support the development targets set. A careful review of this question could well be undertaken during the implementation of the Plan.

To sum up, the revised Kenya Development Plan for the period 1966-1970

seems to be a 'moderate'[7] plan for accelerating future development. It remains to be seen whether most of the Plan goals will be achieved in the process of implementation. What the model comparison has done is to bring out those aspects of the Plan that need careful attention during the Plan period if the targets set are to be achieved.

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[7] According to the definition in 'Development Planning in East Africa', by P. G. Clark, Chp. V, pages 96-98.

APPENDIX

A PROJECTION MODEL FOR EAST AFRICAN ECONOMIES (WITH SPECIAL REFERENCE TO KENYA), ADAPTED TO AVAILABLE STATISTICS*

A. Variables

G.D.P. = gross domestic product = monetary G.D.P. at factor cost.

P_a = gross product of agriculture = agriculture, livestock, forestry, fishing and hunting.

P_m = gross product of manufacturing = manufacture of food products, miscellaneous manufacturing, mining and quarrying.

P_k = gross product of construction = construction.

P_t = gross product of transport = transport, storage and communications, electricity and water.

P_s = gross product of services = commerce, miscellaneous services (private), rents.

P_g = gross product of government = government administration, miscellaneous services (public), local government.

U = urban gross product = $P_g + P_m + P_s + P_t$

M = imports = net imports, interterritorial imports.

M_a = imports of food = SITC 0, 1, 4.

M_m = imports of consumer manufactures = SITC 5 (part), 6 (part), 7 (part), 8 (part), 9 (part).

M_v = imports of consumer vehicles = SITC 6 (part), 7 (part).

M_i = imports of intermediate goods = SITC 2 (part), 5 (part), 6 (part), 8 (part), 9 (part).

M_f = imports of fuel = SITC 3.

M_k = imports of construction materials = SITC 2 (part), 6 (part), 7 (part), 8 (part).

M_q = imports of equipment = SITC 7 (part), 8 (part).

E = exports = domestic exports, interterritorial exports.

E_a = agricultural exports = SITC 0, 1, 2, 4.

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* This is taken from Clark's article referred to above.

E_m = manufactured exports = SITC 3, 5, 6, 7, 8, 9.

T = terms of trade adjustment = E_a(1958 prices) less E_a.

E_a^* = real agricultural exports = E_a + T.

P_a^* = real gross product of agriculture = P_a + T.

G.D.P.* = real gross domestic product = G.D.P. + T.

K = construction investment = gross capital formation: government construction plus private construction.

K_{gc} = central government expenditure on construction.

K_p = private construction = remainder: urban building, rural industrial building and construction.

Q = equipment investment = gross capital formation: government equipment plus private equipment.

Q_{gc} = central government expenditure on equipment, including vehicles.

Q_p = private equipment = remainder: plant, equipment, and vehicles.

G = total central government expenditures = actual recurrent expenditures, less public debt transactions, pensions and gratuities, passages and overseas addition, construction and equipment (except for E.A.C.S.O.) for fiscal year beginning in any calendar year.

R = government revenue = actual recurrent and non-recurrent revenue, less public debt transactions, reimbursements, and grants from abroad, for fiscal year beginning in any calendar year.

R_d = revenue from direct taxes.

R_e = revenue from export taxes.

R_m = revenue from customs.

R_i = revenue from indirect taxes = excises, licences and fees, rents and interest, miscellaneous contributions from local funds.

Y = private income = gross domestic product less government revenue.

S_m = import substitution in manufacture = decrease in imports of food consumer manufactures, intermediate goods, and construction materials, compared to what imports would be with unchanged import coefficients.

B. The Model.

(i) Identities:

1. G.D.P. = $P_a + P_g + P_m + P_s + P_t + P_k$.
2. U = $P_g + P_m + P_s + P_t$.
3. M = $M_a + M_m + M_v + M_i + M_f + M_k + M_q$.
4. E = $E_a + E_m$
5. E_a^* = $E_a + T$
6. P_a^* = $P_a + T$.
7. G.D.P.* = G.D.P. + T.
8. K = $K_{gc} + K_{gI} + K_p$.
9. K_I = $K_p + K_{gI}$.
10. Q = $Q_{gc} + Q_{gI} + Q_p$.
11. Q_I = $Q_p + Q_{gI}$.
12. R = $R_d + R_m + R_i$.
13. Y = G.D.P. - R.

(ii) Exogenous Variables: E_a, T, E_m, G, K_{gc}, Q_{gc}.

(iii) Equations:

1. P_a^* = $a_1 E_a^* + a_2 Y + a_3 E_m$.
2. P_g = gG.
3. P_m = $m_1 Y + m_2 E_m + m_3 Q$.
4. P_s = $s_o + s_1 Y$.
5. P_t = $t(P_a^* + P_m)$.
6. P_k = $h_1 K$.
7. M_a = $c_1 Y$.
8. M_m = $c_2 Y$.
9. M_v = $c_3 Y$.
10. M_i = $i_1 G.D.P.^* + i_3 E_m$.
11. M_f = $i_o + i_2 G.D.P.^*$
12. M_k = $j_1 K$.
13. M_q = $j_o + j_2 Q$.
14. K_I = $k^L U$.
15. Q_I = $q^L U$.

16. $K_p = P_1 K_I$

17. $Q_p = P_2 Q_I$

18. $R_d = r_1 Y.$

19. $R_m = r_3 M.$

20. $R_i = r_4 Y.$

C. Parameters.

(Note: Parameters were estimated from annual observations for the year 1957 - 1963).

$a_1 = .908$

$a_2 = \dfrac{P_a^* - a_1 E_a^* - a_3(E_m + S_m)}{Y}$

$a_3 = .114$

$m_2 = .585$

$i_3 = .301$

(Note: a_3, m_2 and i_3 were estimated from the appropriate proportion in 1961 value of output of all manufacturing in Kenya of (a) domestic agricultural inputs, (b) manufacturing value added plus domestic non-agricultural inputs, (c) imported inputs).

$m_1 = \dfrac{P_m - m_2(E_m - m_3 S_m)}{Y}$

$s = P_s/Y$

$t = P_t/(P_a^* + P_m).$

$h = P_k/K.$

$c_1 = M_a/Y.$

$c_2 = M_m/Y.$

$c_3 = M_v/Y.$

$i_1 = \dfrac{M_i - i_3(E_m + S_m)}{G.D.P.^*}$

$i_2 = M_f/G.D.P.^*$

$j_1 = M_k/K$

$j_2 = M_q/Q$

$k^1 = (\text{Sum } K - \text{sum } k_2 U)/_d U.$

$q^1 = (\text{Sum } Q - \text{Sum } q_2 U)/_d U.$

$$p_1 = K_p/K.$$

$$p_2 = Q_p/Q$$

$$r_1 = R_d/Y$$

$$r_2 = R_e/E_a$$

$$r_3 = R_m/M$$

$$r_4 = R_i/Y.$$